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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/016,896	12/13/2001	Yu-Chi Sun	B-4418 619378-8	9624

7590 05/04/2004

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EXAMINER
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NGUYEN, THANH T

ART UNIT	PAPER NUMBER
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2813

DATE MAILED: 05/04/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/016,896

Applicant(s)

SUN ET AL.

Examiner

Thanh T. Nguyen

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 2/5/04 ~~04 August 2003~~.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-7 and 23-25 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-7, 23-25 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

## **DETAILED ACTION**

### ***Response to Arguments***

Applicant's arguments with respect to claims 1-7, 23-25 have been considered but are moot in view of the new ground(s) of rejection.

### ***Claim Rejections - 35 USC § 112***

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-7, 23-25 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 1 recites the limitation "the C<sub>5</sub>F<sub>8</sub>/CHF<sub>3</sub>" in line 10. There is insufficient antecedent basis for this limitation in the claim. It is suggested to replace with --the C<sub>5</sub>F<sub>8</sub> and CHF<sub>3</sub>--.

Claim 25 recites the limitation "the ion-implanting region" in line 4. There is insufficient antecedent basis for this limitation in the claim. It is suggested to replace with --ion-implanting region--.

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-7, 23-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kang (U.S. Patent Application Publication No. 2002/0045353 A1) in view of Kim et al. (U.S. Patent No. 6,316,349), and further in view of Thei et al. (U.S. Patent No. 6,335,249), and further in view of Pall et al. (U.S. Patent No. 6,337,244).

Referring to figures 1-2B, Kang teaches a method of forming a self-aligned contact hole suitable for a semiconductor substrate having a pair of gate electrodes (52) comprising the steps of:

Forming a nitride etching stop layer (54, called "etch barrier" in Kang, see figure 2a, paragraph# 35) over the gate electrode (52, see figure 2a) and the semiconductor substrate (50, see figure 2a),

Forming an oxide insulating layer (56, see figure 2a, paragraph# 33-34) on the nitride (54), and

Plasma-etching the oxide-insulating layer (59, called "dry etching" and is a plasma in Kang, see paragraph# 35-36) by etching gas consisting  $C_4F_6$  and  $CHF_3$  or  $C_5F_8$  and  $CHF_3$  when  $n=4$  or  $5$  and Ar so as to form a self-aligned contact hole (SAC, see figure 2a, paragraph# 36, and claims 1, 3-7) between the pair of gate electrode (52, meeting claims 1, 9, and 16).

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Regarding to claims 2, the oxide-insulating layer is BPSG (see paragraph# 26).

Regarding to claims 4, the nitride etching stop layer is silicon nitride (see paragraph# 33).

Regarding to claims 6, the etching gas further comprises an inert gas (called “noble/rare gas” in Kang, see paragraph# 31).

Regarding to claims 7, the inert gas is argon gas (see paragraph# 31).

Noted that it would have been obvious to a person of ordinary skill in the requisite art at the time of the invention was made that using the same etchants  $C_4F_6$  and  $CHF_3$  or  $C_5F_8$  and  $CHF_3$  when  $n=4$  or  $5$  and Ar so as to form a self-aligned contact hole (SAC, see figure 2a, paragraphs# 30, 36) to etch the same material would provide the equalizing the etching rate to the etching stop layer at the top corner and the bottom of the contact hole (see figures 2a-2b).

It is held, absent evidence to the contrary that cooling (decreasing) the temperature of the layer after annealing in order to facilitate handling. See In re Best, 195 USPQ 428 (CCPA 1977) and In re Fitzgerald, 205 USPQ 594 (CCPA 1980).

Kang teaches a method of forming a self-aligned contact hole by etching the silicon oxide layer using  $C_5F_8/CHF_3/Ar$ , but fail to teach forming an oxide insulating layer by using a reactive gas containing TEOS. Nevertheless, forming an oxide insulating layer by using a reactive gas containing TEOS is known in the semiconductor processing art as evidenced by Kim et al.. Kim et al. teaches Forming a nitride etching stop layer (57, called “etch barrier” in Kim et al., see figure 5, col. 8, lines 18-21) over the gate electrode (53, see figure 5, col. 8, line 14) and the semiconductor substrate (51, see figure 5, col. 8, line 47), forming oxide insulating layer by using a reactive gas containing TEOS (see figure 6, col. 8, lines 40-42) on the nitride etching stop layer (57, see figure 7, col. 8, lines 49-52), and Plasma-etching the oxide-insulating layer

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(59, called “dry etching” and is a plasma in Kim et al., see col. 15, line 34) by etching gas containing  $C_4F_6$  and  $CHF_3$  or  $C_5F_8$  and  $CHF_3$  when  $n=4$  or  $5$  so as to form a self-aligned contact hole (SAC, see figure 7, col. 8, lines 1-2, and col. 9, lines 15-21) between the pair of gate electrode (53, meeting claims 1, 9, and 16).

Therefore, it would have been obvious to a person of ordinary skill in the requisite art at the time of the invention was made would form an oxide insulating layer by using a reactive gas containing TEOS in process of Kang as taught by Kim because the process would the material would provide the planar surface and also determining the optimum material for the layer only involved routine skill in the art.

Kang also fails to teach forming an etch stop layer of oxidized silicon-rich nitride layer (57) can be silicon oxy-nitride. Nevertheless, forming an etch stop layer of silicon oxy-nitride is known in semiconductor processing art as evidenced by Thei et al.. Thei et al. teach a method of forming a self-aligned contact hole (2, see figure 1), forming a gate electrode (16, see col. 1, line 60), forming an etch stop/barrier layer such as silicon oxy-nitride (24, SiON, see figure 1, col. 2, lines 18-20) over the gate electrode (16), forming a interlevel dielectric layer (28, BPSG, see col. 2, lines 20-23), plasma etching the layers to form the opening (2, see figure 1, col. 2, lines 24-26).

Regarding to claim 24, the thickness of the oxide layer 6000-10000 angstroms (see col. 6, lines 48-59).

Regarding to claim 25, the nitride etching stop layer (24, SiON) in the contact hole (2) is removed after the step of etching the oxide (28) by etching to expose the ion-implanting region (19) (see figures 3-4).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time the invention was made would form an etch stop layer of oxynitride in process of Kang and recognized Kang's oxidized silicon-rich nitride layer having Si-O, Si-Si bond and SiN bond can be an oxynitride layer (SiON) as taught by Thei et al. *because* forming an etch stop layer such silicon oxy-nitride would increase the etching selectivity of oxide layer to silicon oxy-nitride layer during the formation of a self-aligned contact hole, so that plasma etching would not etch the gate electrode.

Kang teaches a method of forming a self-aligned contact hole by etching the silicon oxide layer using  $C_5F_8/CHF_3/Ar$ , but fail to teach the specific  $C_5F_8/CHF_3$  mixture ratio of the etching gas that is between 0.4-0.75. Nevertheless, using  $C_5F_8/CHF_3$  mixture ratio of etching gas that is between 0.4-0.75 to etch oxide layer as evidenced by Pall et al. Pall et al. teaches forming a self-aligned contact hole using mixture of  $C_5F_8/CHF_3$  gas at ratio of between about 0.2-5 (see Pall's claims 6, 39 and col. 6, lines 27-35 and col. 8, lines 1-14).

Regarding to claim 23, the pressure of the plasma chamber during etching the oxide layer is about 30-70 mtorr (see col. 6, lines 36-47).

It has been held that when the general condition of a claim are disclosed in the prior art that it is not inventive to discover the optimum or workable ranges prior art reference that discloses a range encompassing a somewhat narrower claimed range is sufficient to establish a prima facie case of obviousness." In re Peterson, 315 F.3d 1325, 1330, 65 USPQ2d 1379, 1382-83 (Fed. Cir. 2003). However, if the reference's disclosed range is so broad as to encompass a very large number of possible distinct compositions, this might present a situation analogous to the obviousness of a species when the prior art broadly discloses a genus. Id. See also In re

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Baird, 16 F.3d 380, 29 USPQ2d 1550 (Fed. Cir. 1994); In re Jones, 958 F.2d 347, 21USPQ2d 1941 (Fed. Cir. 1992); MPEP § 2144.08.

Therefore, it would have been obvious to a person of ordinary skill in the art would use a mixtures of  $C_3F_8/CHF_3$  gas with ratio of 0.4-0.75 to etch an self-aligned contact hole in the process of Kang et al. because the higher the etching selectivity of silicon oxide to silicon nitride layer would prevent over etching on the gate electrode.

The concentration range of claims 3-5, 9, 14-16, 20, and 35-38 and the concentration range of claims 6-8, and 17-19 are considered to involve routine optimization while has been held to be within the level of ordinary skill in the art. As noted in In re Aller, the selection of reaction parameters such as temperature and concentration would have been obvious:

"Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art...such ranges are termed "critical ranges and the applicant has the burden of proving such criticality.... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."

*In re Aller* 105 USPQ233, 255 (CCPA 1955). See also *In re Waite* 77 USPQ 586 (CCPA 1948); *In re Scherl* 70 USPQ 204 (CCPA 1946); *In re Irmscher* 66 USPQ 314 (CCPA 1945); *In re Norman* 66 USPQ 308 (CCPA 1945); *In re Swenson* 56 USPQ 372 (CCPA 1942); *In re Sola* 25 USPQ 433 (CCPA 1935); *In re Dreyfus* 24 USPQ 52 (CCPA 1934).

Therefore, one of ordinary skill in the requisite art at the time the invention was made would have used any thickness range and the pressure range suitable to the method in process of Kang in order to optimize the process.

### ***Response to Arguments***

Applicant's arguments with respect to claims 1-7, 23-25 have been considered but are moot in view of the new ground(s) of rejection.



Applicant contends that the reference does not teaches the range of 0.4-0.75. In response to applicant that It has been held that when the general condition of a claim are disclosed in the prior art that it is not inventive to discover the optimum or workable ranges prior art reference that discloses a range encompassing a somewhat narrower claimed range is sufficient to establish a prima facie case of obviousness.” In re Peterson, 315 F.3d 1325, 1330, 65 USPQ2d 1379, 1382-83 (Fed. Cir. 2003). However, if the reference’s disclosed range is so broad as to encompass a very large number of possible distinct compositions, this might present a situation analogous to the obviousness of a species when the prior art broadly discloses a genus. Id. See also In re Baird, 16 F.3d 380, 29 USPQ2d 1550 (Fed. Cir. 1994); In re Jones, 958 F.2d 347, 21USPQ2d 1941 (Fed. Cir. 1992); MPEP § 2144.08.

Therefore, it would have been obvious to a person of ordinary skill in the art would use a mixtures of  $C_5F_8/CHF_3$  gas with ratio of 0.4-0.75 to etch an self-aligned contact hole in the process of Kang et al. as taught by Prall because the higher the etching selectivity of silicon oxide to silicon nitride layer would prevent over etching on the gate electrode.

The burden is shifted to the applicant to show side by side example of overlapping range as taught by Prall does not teach the unexpected result of equalizing the etching rate to the etching stop layer at the top corner and the bottom of the contact hole when using the mixture ratio or etching gas.

### **Conclusion**

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

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A shortened statutory period for response to this final action is set to expire THREE MONTHS from the date of this action. In the event a first response is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event will the statutory period for response expire later than SIX MONTHS from the date of this final action

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanh Nguyen whose telephone number is (571) 272-1695, or by Email via address Thanh.Nguyen@uspto.gov. The examiner can normally be reached on Monday-Thursday from 6:00AM to 3:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached on (571) 272-1702. The fax phone number for this Group is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956 (See MPEP 203.08).



Thanh Nguyen  
Patent Examiner  
Patent Examining Group 2800